OFFICE MEMORANDUM

MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

October 4, 1972

To: Max N. Clyde
Engineer of Testing and Research

From: L. T. Oehler

Subject: The Effects of Pavement Drainage Gratings on Bicycle Control for Narrow-Tired Bicycles. Research Project 72 TI-101, Research Report No. R-834.

Recently there have been a number of references and news articles concerning safety in connection with narrow-tired bicycles traversing pavement drainage gratings. One article and picture in the Flint Journal of April 13, 1972 was titled, "Catch Basins Are Termed Treacherous." The catch basin illustrated in the article was the sinusoidal grating type such as shown in Standard Plan E-4-A-27G Cover C-5 and several other Standard Plans. In order to determine the extent of this alleged problem a series of tests have been conducted which are reported here.

In connection with the development of the sinusoidal grating it should be pointed out that the effect of narrow bicycle tires was carefully considered and tests were conducted with an English-style bicycle. The bicycle ran over this grating with no effect on its steering. Standard Plans indicate that this type of grating was adopted in 1963 by the Department and, until the recent news article, it had not come to our attention that any problems might exist in this regard. However, bicycle manufacturers in the past few years have made considerable changes in the width of tires, particularly on the racing-type bicycles which have become very popular in the last few years. Thus, if a problem has developed since 1963 it is due to this trend on the part of the manufacturers to produce narrower tires. We understand that they are aware of this potential problem and have given warnings in certain racing literature concerning the matter of riding over catch basin gratings.

Discussion with local bicycle shops and bicycle riders confirm that very narrow tires are now being produced. Three nominal dimensions for these tires are 26 by 1-3/8 in., 27 by 1-1/4 in., and 27 by 1 in. Currently the narrowest tire measures about 1 in. Preliminary testing was done with a Raleigh racing-type bicycle with nominal 27 by 1-1/4 in. tires. An exact measurement indicated that these tires when properly inflated measured 1.128 in. in width. The opening of the sinusoidal grating is given on the Standard Plans as 1-1/2 in. As shown in Figure 1, a tire of this width when aligned at a certain angle of about 15 degrees will penetrate the sinusoidal type grating but does not penetrate the rectangular grating as illustrated by Figure 2. The rectangular grating has a greater width of opening, 2-1/8 in., but with transverse supports at 4-in. intervals no bicycle tire penetration results.

On July 20, a series of tests with the same Raleigh bicycle were conducted over the sinusoidal grating on East Saginaw St. near Pennsylvania Ave. in order to determine the effect this grating might have on bicycle control. As shown in Figure 3, it was possible to place the front wheel of the bicycle at such an angle that the tire penetrated the grating under a static condition. However, a large number of passes of the bicycle over the grating at a variety of angles (Fig. 4) did not result in any significant effect on bicycle steering or control. Bicycle speeds were also varied in these runs from slow to the maximum attainable under the situation. At times during these runs there was a penetration of the bicycle tire into the grating but the bicycle momentum in every case carried the tire over the grating with only a very slight or noticeable ride effect and no significant steering correction was required. Even with a very relaxed condition of the bicycle rider's hands on the handle bars no steering correction was required. The higher speed runs resulted in less effect than the slower speeds probably due to the increased momentum resulting in less grating penetration. No attempt was made to go over the grating without hands on the handle bars although the tests conducted would indicate that this would not be a problem. It has also been mentioned that the bicycle grating problem might be more serious under wet conditions. In order to check this the grating was wetted and a number of tests conducted under this condition. These tests indicated that there was no difference between wet and dry conditions and that under either condition there was no appreciable effect on bicycle steering or control. As a result of this series of tests no damage resulted to the tire or the rim of the bicycle, although there were a number of black marks on the tire sidewall resulting from the contact with the sides of the grating bars.

TESTING AND RESEARCH DIVISION

L. R. Tolle

Engineer of Research

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Figure 1. Racing bicycle tire penetrating opening in sinusoidal type grating.

Figure 2. Same bicycle tire on rectangular grating.

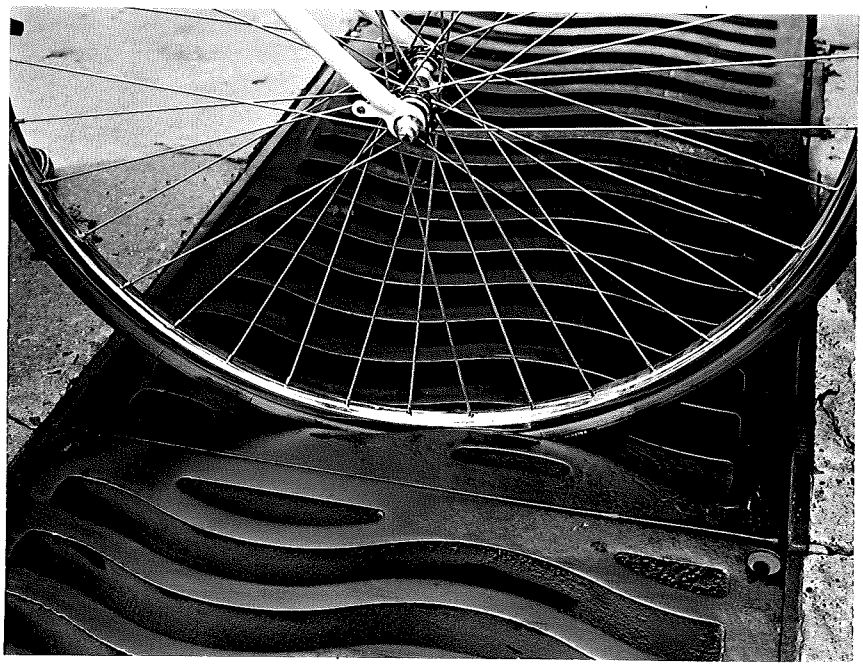

Figure 3. Penetration of narrow bicycle tire into sinusoidal grating under static conditions, Saginaw St. tests.

Figure 4. Bicycle test runs at various speeds and angles over sinusoidal grating.